What is Happening in Scrooge Digiduck's Warehouse?

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Inaugural address by Ron J. Berndsen

Tilburg University

Understanding Society

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What is happening in Scrooge Digiduck's Warehouse?

Inaugural address given by Professor Dr R.J. Berndsen on his acceptance of the position of endowed professor of Financial Infrastructure and Systemic Risk at the University of Tilburg on Friday, 25 February 2011

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Rector,

fellow professors of the university and colleagues,

ladies and gentlemen,

It is with great pleasure that I accept the position of endowed professor of Financial Infrastructure and Systemic Risk at the University of Tilburg with the inaugural address entitled 'What is happening in Scrooge Digiduck's warehouse?'[1]

As economic students learn very early on in their studies, money has three functions: it serves as a unit of account, as a store of value and as a medium of exchange. They then learn why money as an intermediate step is so much more useful than pure bartering. The person who has a sheep but wants bread must search for someone with exactly the opposite need. In economics, this is referred to as the 'double coincidence of wants' and this is roughly how the function of money as a medium of exchange is dealt with in lectures. But in the literature as well, we only encounter the medium of exchange function of money to a limited extent.[2] Generally, money as a medium of exchange is simply ignored. In economics, therefore, too little attention is paid to this function; this is understandable, but not a good thing.

It is understandable because this function is largely carried out behind the scenes. It is embodied in the financial infrastructure. Later, I will provide a formal definition of the financial infrastructure, but first a definition that all of you as hands-on experts have with every infrastructure: a network that you use without further thought as long as it works, but which is very annoying when it does not. There are plenty of examples: the internet connection that is suddenly very slow, the electricity network that shuts off the power for several hours or the POS terminal that refuses your debit card. Let's say that, 99% of the time, you can assume that the network will do what it is supposed to do. Furthermore, the service supplied by the network is basic in nature and, for this reason, not very exciting. I know of very few people who regard the activity of making payments itself as an interesting one, apart from colleagues from the Cash and payment systems Division of De Nederlandsche Bank.

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[1] With thanks to Lex Hoogduin, Coen Voormeulen and colleagues from the Oversight Department for their useful comments on an earlier version of this speech.

[2] Research output by central banks in this field is rapidly growing, however. See, for example, the Payment Economics Network (www.ecb.int).

Nevertheless, it is not a good thing to pay little attention to the final 1%, because infrastructure that is affected by a disruption can have major implications for society. It is no different for the financial infrastructure. If money is temporarily unable to fulfil the function of a medium of exchange, it will not be possible to transfer value in the economy and no financial transactions can be settled. Greenspan [4][3] articulated this in his autobiography, when he wrote about '11 September 2001' as follows: "We'd always thought that if you wanted to cripple the U.S. economy, you'd take out the payment systems. Banks would be forced to fall back on inefficient physical transfers of money. Businesses would resort to barter and IOUs; the level of economic activity across the country would drop like a rock."

In this speech, I will first talk about how the financial infrastructure is structured for the euro and the euro area. I will then address the implications of a failure of the financial infrastructure and the preventative measures that have been and will be taken. We will then focus our attention on the consolidation and the market regulation of the financial infrastructure. Finally, I will end this speech with a look far into the future of the financial infrastructure for the euro area.

A guided tour around Scrooge Digiduck's warehouse

It's time now to introduce you to Scrooge Digiduck. When the printer was preparing the invitations for this speech, he asked me anxiously whether I did not mean McDuck instead of Digiduck. I reassured him: it was not a printing error, but the two gentlemen are related. As we know, Scrooge McDuck, the immensely wealthy duck from Duckburg, lives in a warehouse full of banknotes and coins, in which he likes to swim. Scrooge Digiduck is the digital brother of Scrooge McDuck and manager of a warehouse that is also full to capacity with money, but in this case, non-cash money. Unfortunately, you can't touch non-cash money, let alone swim in them. The defining characteristic of non-cash money is that it only exists in the form of a credit on an account that an account holder holds with his or her bank. All of the accounts together form the account book, which includes all of the credit balances. Transfer of value takes place by debiting an amount to the payer's balance and then crediting it to the payee's balance. The value of non-cash money therefore only exists in book entry form.

[3] References to the literature are given in square brackets and are listed at the end of the text.

Figure 1 Scrooge Digiduck's warehouse

It's high time we entered the warehouse because Scrooge Digiduck has been eagerly waiting to give us a guided tour for some time. Immediately, we notice that the warehouse is only three floors high (see Figure 1), but it includes all 17 countries in the euro area.[4] At the end of 2009, the value stored in the warehouse was over EUR 36,000 billion. Almost EUR 5,500 billion flows through it daily; this means that a value equal to the gross domestic product of the euro area is processed every two days.

4 The infrastructures shown are taken from [6]. With thanks to Richard Heuver for his invaluable assistance with producing the graphics.

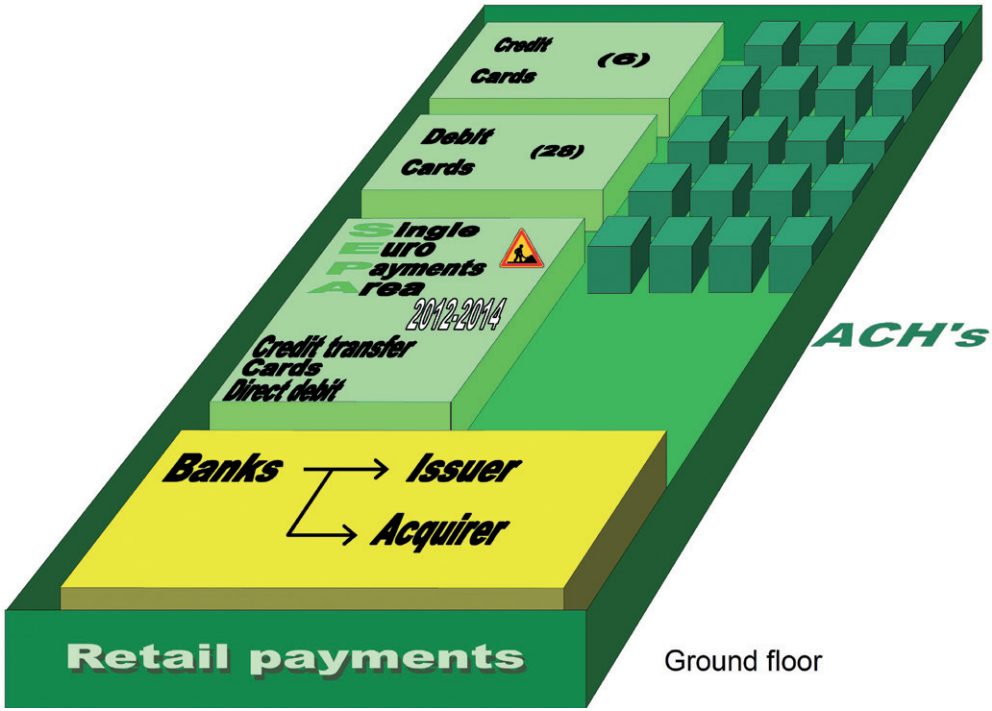

Figure 2 Retail payments in the euro area (simplified diagram)

We enter the ground floor and come to retail payments. Retail payments are the payments that everyone in the economy comes into contact with on a daily basis (see Figure 2). They include all payments made by consumers and businesses, using a range of different payment products: direct debits, credit transfers, card payments (debit or credit cards), prepaid cards, and internet payments, such as iDeal and Paypal. At the end of 2009, a total of approximately EUR 4,100 billion of non-cash money was held on current accounts.[5] Digiduck always uses this figure to torment McDuck because there is a lot more non-cash money than there are euro notes and coins (EUR 829 billion). There is a rumour that the notes and coins are stored in the cellar of the warehouse. McDuck torments him back by saying that he would rather be the owner of part of this than merely the manager of the entire warehouse. Well, that's enough of this rivalry.

5 The statistics for the euro area in this speech are from the Statistical Data Warehouse, www.ecb.int, and relate to 2009.

As the Dutch proverb goes: 'money should circulate', and it does. In the case of retail payments in the euro area, we are talking about a flow of about EUR 60 billion per day. Looking around this floor, we see a fragmented picture. In most countries, the infrastructure is tailored to the domestic situation. Take the Netherlands, for example. A section of the warehouse is actually here: those of you sitting in the audience have an average of two payment cards in your wallet, and many of you have a card reader at home or a mobile that you can use to create one-time passwords for internet banking. There are also 8,000 ATMs and 259,000 POS terminals in the Netherlands that you can use to make debit card payments. In the euro area, there are about 28 types of debit cards and 6 types of credit cards in circulation. A payment can be initiated using all of the payment products referred to here. These are what are called one-sided financial transactions, because only one side is financial in nature. For payment products where verification of sufficient funds needs to be carried out on the spot (such as in the case of debit card payments in a store), a check needs to be carried out between the bank of the retailer (acquirer) and the bank of the customer (issuer). To this end a 'switch' is used: a central piece of infrastructure that Scrooge Digiduck uses, as a digital payment agent, to route the information stream along the right paths.[6] This keeps him pretty busy, particularly in December. In the Netherlands, in the days running up to St Nicholas' Eve (5 December) and Christmas, between 2 p.m. and 3 p.m. local time, he routes 400 streams per second in the right direction. These requests for payment then come together with almost all of the other payment instructions into a single system that clears retail payments in the Netherlands. Such an infrastructure is referred to as a 'retail payment system' or 'automated clearing house' (ACH). In the euro area, there are about 20 ACHs in total. In the Netherlands, this role has been fulfilled by Equens for a long time. In this context, clearing refers to, in the retail payment system, the determination of the amount each bank has to pay on behalf of its customers to each other bank and how much money each bank should receive for its customers from each other bank (gross). In the case of the Netherlands, there are about 17 million interbank transactions per day and Equens clears at least every 30 minutes. Apart from clearing, netting can also be carried out: the immediate setting off of amounts that are payable by one party to another and vice versa (net). Particularly in the case of large numbers of transactions within a limited group, it is often possible to net off a significant part of the originally payable amounts.

Suddenly, we hear the noise of hammer drills. They make such a racket that our guide becomes virtually inaudible. Digiduck apologises for the extensive building alteration works. He points to a sign saying 'Single Euro Payments Area (SEPA) 2012-2104', and

[6] If the consumer and the retailer are with the same bank, the bank can carry out the payment internally (an 'on us payment').

promises us more information about this later. Our guide sees someone raising their hand. The person wonders, even after swiping the debit card, switching, clearing and netting, is it true that payment has not yet actually been carried out? Digiduck nods in agreement and replies that, for this, we need to go to the first floor of the warehouse: large-value payment systems.

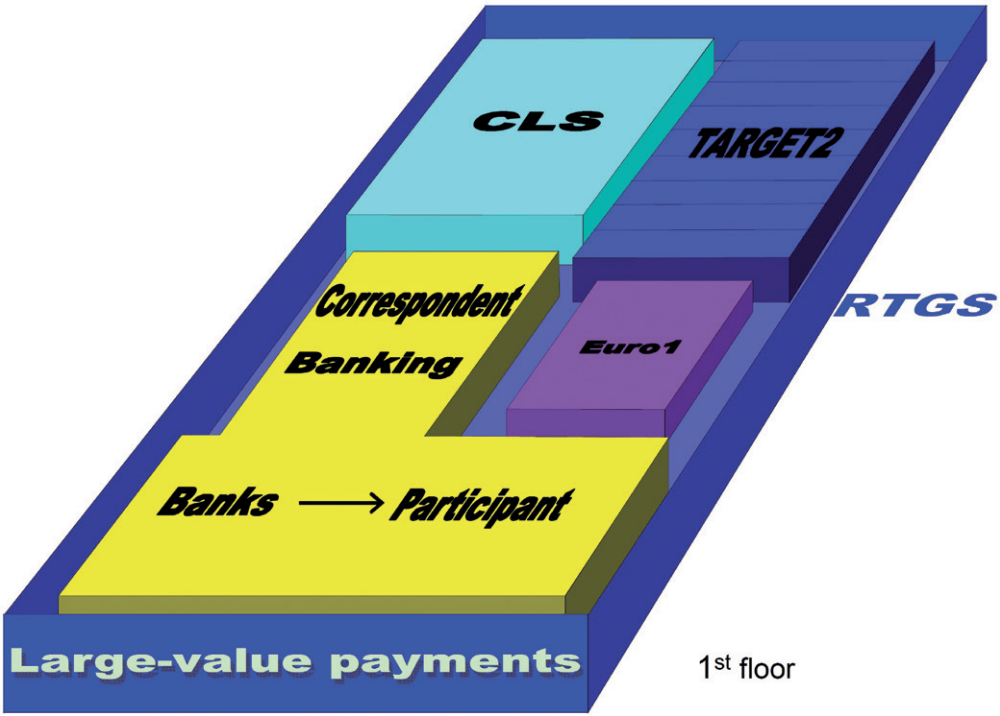

Figure 3 Large-value payment systems in the euro area (simplified diagram)

Large-value payments (see Figure 3) are payments for large amounts between banks, for themselves and for their customers. This can be divided into two categories. The first category is correspondent banking. A correspondent banking payment is a payment between two banks that is made through an intermediary (the correspondent bank). This payment method was very common with foreign currency payments. As a result of the introduction of the euro and in the wake of the financial crisis, there has been evidence of a decline in corresponding banking payments. This is because the second category is becoming more important: central infrastructure payments. Digiduck says that EUR 2,900 billion changes hands daily in large-value payment systems. Rapid inspection of this floor reveals that

there are only three rooms, which are also interlinked. It is also clear that the major building alterations here are already finished. Digiduck points proudly to the modern, brand-new layout of the room where TARGET2[7] operates, the payment system of the central banks in the euro area, which has been fully operational since May 2008. This system is used to execute the monetary policy transactions of the Eurosystem [6] and to carry out payments between about 4,500 banks in the euro area where payment can be made using money of the national central banks and the European Central Bank. This type of money is central bank money, which is ideally suited for such large amounts because, in practical terms, a central bank cannot fail. A second important feature of TARGET2 is immediate settlement, in real time, of individual payments. These systems are therefore referred to by the term 'Real-Time Gross Settlement (RTGS)'. Settlement is the step in the payment chain when transfer of ownership takes place, the 'real payment', by debiting one account and crediting another account with the same amount.

A second system that is housed on this first floor is EURO1. This system also settles large-value payments between banks on a European scale and is a private initiative of more than 60 major European banks. EURO1 and TARGET2 are interlinked because EURO1 settles in TARGET2. This third room is occupied by CLS (Continuous Linked Settlement), the global payment system in which foreign exchange transactions are settled. This warehouse only houses the euro part of CLS: it deals with two-sided financial transactions, with the most frequent currency pair being euro/dollar. Here, Digiduck asks you to recall the netting of payments that he mentioned during the discussion on the ground floor, for CLS is a wonderful example of the positive value of netting: it reduces the volume of liquidity required. On an average day, if we total all of the currencies and convert them into US dollars, CLS needs to settle about USD 3,000 billion gross between about 50 banks. However, netting makes it possible to cancel out 99% of the value, so that, on a net basis, only about USD 30 billion of liquidity needs to be injected, i.e. an average of USD 600 million per bank. For a large bank, that is not an unusually large amount to be paid in a single sum through a large-value payment system. This advantage becomes even greater in absolute terms on peak days in CLS; the gross record on a single day was USD 10,000 billion.

7 TARGET2 stands for Trans-european Automated Real-time Gross Express Transfer, and the suffix 2 refers to the second generation. The first generation of TARGET was launched when the euro was introduced, on 1 January 1999, when the existing national systems were made interoperable.

Digiduck now refers to the earlier questions about where Dutch retail payments (you know, the one on the ground floor) are ultimately paid. The answer to this is in TARGET2, with a frequency of at least once every 30 minutes. TARGET2 is therefore not only used for interbank payments, but also as a settlement system for the clearing of retail payments. This is a good example of a link between two infrastructures, in this case, between the automated clearing house Equens and TARGET2. Such links between the ground floor and the first floor occur frequently, given that over 30 retail payment systems in the euro area settle in TARGET2.

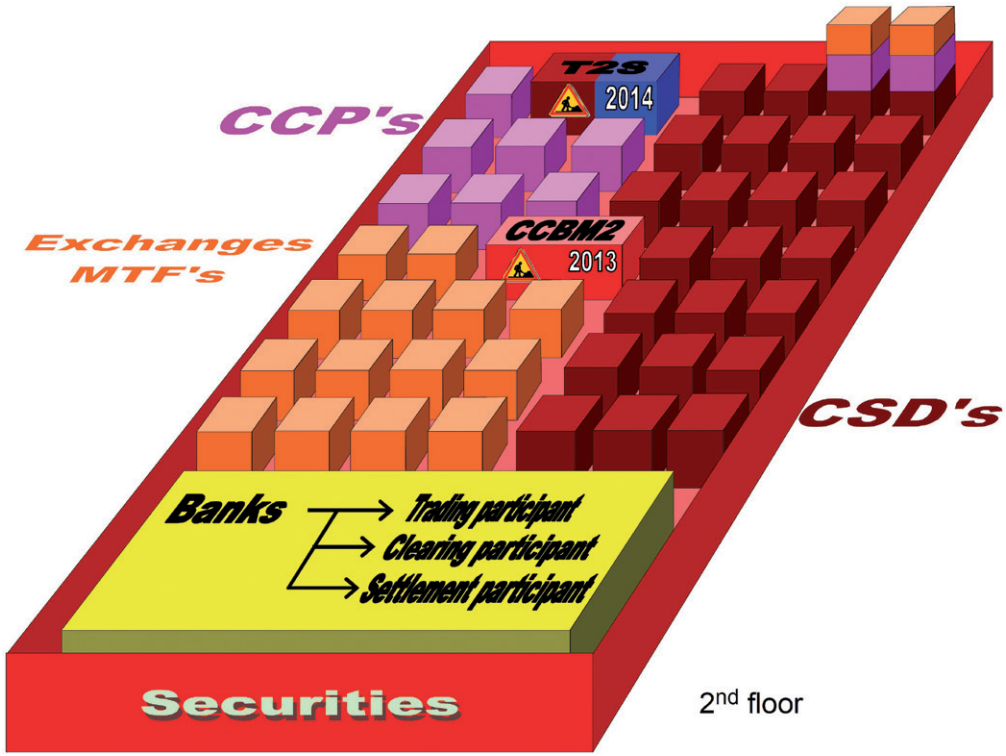

Figure 4 Securities in the euro area (simplified diagram)

Scrooge Digiduck points to the approximately 20 cables that disappear into the ceiling: there are also many links between the first and second floors. We go up to the second floor of the warehouse (see Figure 4), which means we leave the world of non-cash money and enter the world of securities. This must be the most dynamic floor, because there is still a lot of building work going on here. At the end of 2009, this floor contained

EUR 30,700 billion of securities, shares and bonds that were in issue in the euro area, and of this figure, EUR 2,500 billion changed hands every day. Derivatives trading and clearing, which involve the circulation of even larger amounts, have been excluded here for the sake of simplicity.

The securities chain involves transactions executed on stock exchanges and multilateral trading platforms (MTF), but also transactions that are entered into directly between two financial parties (over the counter, OTC). Digiduck suggests that we familiarise ourselves with the securities chain by following one transaction: a purchase of shares on the stock exchange. In this case, the securities chain starts with the stock market trade, where the buyer and seller are matched. This is a two-sided transaction. The transaction is confirmed and then cleared. In some cases, this may be done by a central counterparty (CCP) and then the securities side is settled in a central securities depository (CSD) and the money side is settled in the RTGS. The CSD changes the ownership of the shares from the seller to the buyer, and exactly the opposite happens for the money in the RTGS. The shares are held via banks, which in turn place the shares in the custody of a central securities depository (CSD)[8]. In the securities chain, there are therefore various types of infrastructure in operation: stock exchange, MTF, CCP, CSD and RTGS.

In the case of securities trading, we are familiar with MTFs and the stock exchange, which previously had a trading floor, but now the trading is via screens or even without human intervention. In the case of off-exchange trading (OTC) in derivatives, a new type of infrastructure has recently emerged: the trade repository. However, Digiduck thinks that the name 'trade warehouse' is far more appropriate. Worldwide, there are now three of these trade warehouses in operation, and two more are currently planned. The function of such a warehouse is to collect off-exchange transactions in one location and to make the positions taken by the various trading parties transparent.

The second function in the securities chain is clearing. In terms of function, this clearing is similar to clearing in the case of retail payments, although here it involves the matching and determining the amount of securities to be bought and to be sold for each counterparty. But generally there is an additional function: that of a central counterparty (CCP). A central counterparty gives its members a guarantee (under certain conditions) that the securities receivable by the buyer will actually be delivered, even in the extreme case of failure of the original party with whom the securities are traded. The central counterparty thereby fulfils an insurance role for the failure of a member during the period from when

[8] The settlement function of securities takes place in a securities settlement system (SSS), which is generally part of a CSD. For the sake of simplicity, only a CSD is referred to here.

a trade is entered into and its settlement. For exchange transactions, the period is usually three days, which is referred to as T+3.

The third function is the settlement of securities. The infrastructure that is used for this function is the CSD. Within the CSD, the actual transfer of value takes place against a modern version of 'paying in cash', referred to as delivery versus payment (DVP). For this to happen, a link is needed between the second and the first floors of the warehouse, between CSD and RTGS. The concept is simple: the transfer of the securities in the CSD is made conditional upon the transfer of funds in the RTGS and vice versa. If both conditions are met, there is a simultaneous exchange.[9] For this to happen, it is therefore necessary that the process is a joint one and this also requires cooperation between the central bank and the CSD.

The second floor, however, is home to more than just securities settlement. In the same way that non-cash money is stored electronically in the form of balances on bank accounts with commercial banks and central banks, so securities are also stored with custodian banks and in CSDs. Previously, this custodial function was a physical one, in the form of a safe, where the securities were stored in paper form. In the near future, virtually all Dutch securities will be in dematerialised form.[10]

Digiduck admits that, unfortunately, the second floor still looks very unstructured and not very uniform. There are many rooms housing different parts of the infrastructure. Some rooms have high ceilings; they contain what is referred to as a 'vertical silo'. This is the case if the stock exchange, CCP and CSD are controlled by the same financial group. In other rooms on this floor, there is a horizontal model, in which the securities chain can run through different infrastructures. There are 9 central counterparties in the euro area and still 24 CSDs continue to operate there. A further conspicuous feature of the floor is the very large building pit, right next to the place where the DVP process just described takes place. It will come as no surprise to the experts that the letters 'TARGET2-Securities 2014' are written on it. There is also a room where building is taking place, in the corner where the collateral process is carried out, which is used, among other things, for the creation of central bank money. A sign saying 'Collateral Central Bank Management (CCBM2) 2013' is there. Now we take the lift back down and go outside again.

9 DVP can be structured to take place in different ways. In fact, DVP needs to be viewed in legal terms; the essential point is that at no stage in the process is one of the two parties the legal owner of both the securities and the funds.

10 The date when all securities will be dematerialised or immobilized in the form of a global note, is 1 January 2013.

Scrooge Digiduck announces that the tour of the warehouse is finished; he must begin the monitoring of the end-of-day processes next, because the settlement day is almost over.

A holistic approach to settlement risk

We now come to the definition of the term 'financial infrastructure'. Clearly, Scrooge Digiduck's warehouse is a metaphor for the financial infrastructure, and Scrooge Digiduck is an imaginary digital figure who acts as the manager of the infrastructure. The term financial infrastructure is defined in three elements as follows:

> *1) The system of rules, governance and technical infrastructure that 2) is necessary for the accurate and timely settlement of financial transactions 3) entered into throughout the economy.*

Re 1) The infrastructure is a system of rules, governance and technical infrastructure. It is often thought that financial infrastructure only refers to the hardware and software used in systems, such as communication lines, data centres and terminals of settlement systems and banks. But this is only partly true. Defining and supervising the financial infrastructure relates in the first place to the rules and the governance. Rules in this context refer to all of the formal legislation and regulations, contractual provisions, but also generally accepted standards and market practices. A selection from the many rules: the General Banking Terms and Conditions, which you as a consumer are given when you open a new bank account; the rulebooks of central systems, which may be many pages long; the Dutch Financial Supervision Act, international oversight standards for infrastructures. Then we come to the governance of the financial infrastructure. This needs to be carried out by a legal entity, the governance authority, which is responsible for compliance with the rules, the revision of its own rules and proper management of the part of the financial infrastructure to which the responsibility applies. This may involve public institutions such as central banks, but private bodies, which in turn are often owned by banks, may also serve as a governance authority.

Re 2) This concerns the timely settlement of financial transactions. A financial transaction refers to a transaction where at least one side is financial in nature (such as the purchase of a loaf of bread). In the case of a two-sided financial transaction, both sides are financial (such as the purchase of a bond). As soon as a financial transaction has been entered into but has not yet been settled, the party that needs to receive the financial side is exposed to settlement risk. Roughly speaking, settlement risk (in a broad sense) can be divided into the following three subcategories [1]. First, there is principal risk: the risk that the

counterparty will not deliver the financial value at all (such as in the case of failure of that counterparty). Second, there is liquidity risk: the risk that the counterparty will deliver the financial value too late, or at least later than agreed in the contract. In this case, the party that expects the liquidity at a particular time has a lower cash position than expected. The third and final element of settlement risk consists of 'replacement cost risk', and this only applies to two-sided transactions. This is the risk that a different asset will be delivered to what has been agreed (for example, a different currency). In order to obtain the original asset, additional costs then need to be incurred relative to what would have been the case had the transaction been settled correctly, for example, because the exchange rate of the original currency has risen in the interim. The timely settlement of financial obligations ensures that settlement risk is prevented.

Re 3) The final element of the definition of financial infrastructure concerns financial transactions throughout the economy. This means that it is a macroeconomic phenomenon and emphasises the complementary function: the financial infrastructure does not have an independent objective, but functions for the economy as a whole. When we study the financial infrastructure, we see the economy as the generator of settlement risk exposures (exogenous), but we view the changing and elimination of the set of settlement risk exposures as endogenous [1]. With this explanation of the term financial infrastructure, we come to the essence of the chair in financial infrastructure and systemic risk. The central problem that I will research can be summarised as follows: *given the set of settlement risk exposures in an economy, how can these exposures be eliminated securely and efficiently?* This involves a holistic approach by viewing the financial infrastructure as a whole, i.e. as if it were one warehouse, as I have attempted to describe it above, and not as a loose collection of banks, settlement systems and other economic agents. This is justified by the increased interdependencies [5] on and between the different floors of the warehouse. In other words, how must Scrooge Digiduck's warehouse be structured?

Infrastructure-related systemic risk

In my view, the way that the financial infrastructure should be structured must hinge on the question of whether systemic risk can occur, and if so, where? I will first address the term 'systemic risk'. Systemic risk refers to the risk of major financial instability with substantial negative consequences for the financial sector and the rest of the economy [7]. In this context, 'system' therefore refers to the economy as a whole and is consistent with the systemic risk concept of the brand-new European Systemic Risk Board. As a result of the financial crisis, which has proliferated in all sorts of forms since August 2007, the phenomenon of systemic risk has become all too clear.

The chair is concerned specifically with the relationship between the financial infrastructure and systemic risk. I refer to this as infrastructure-related systemic risk: the component of systemic risk that can be brought about by the improper functioning of the financial infrastructure, or where the financial infrastructure acts as the conduit for shocks that have arisen elsewhere. Given the macro nature of systemic risk, it then relates to large-value payments and securities transactions. The systemic risk inherent in the financial infrastructure for the euro and the euro area is therefore localised on the first and second floors of the warehouse.

Incidentally, this does not mean that the ground floor is always secure. It means that there is no systemic risk inherent in retail payments, but that there is the risk of social unrest if the problems escalate [2]. For instance, if ATMs and POS terminals do not function on a large scale in our country, or if there is cybercrime in retail payments. This will manifest itself in long queues in front of ATMs and problems in stores where it is no longer possible to make payment by debit card. In September and December 2010, a number of disruptions affected debit card payments in the Netherlands for a very short period of time, and in each case for no longer than 30 minutes. Nevertheless, 15 minutes after the start of the failure, reports of it were already on the internet and were buzzing around the social media. What is more, as a result of modern communications, the public perception of a failure - even if everything is running normally - is sufficient to give rise to some concern. In August of last year, the news that 'you can use your debit card for free' was enough to cause a run on a number of ATMs. Using a debit card is, of course, never free, because the cash amount of money was also then simply deducted from the bank account.

Now back to the inherent, infrastructure-related systemic risk. This raises the question about the systemic risk that could manifest in the financial infrastructure if no precautionary measures are taken. You can compare this type of risk with the risk of driving a car on a skid pan without wearing a safety belt. This is good as a thought experiment, but unwise in practice.

The first category of problems concerns failures in the financial infrastructure itself, with the most obvious being operational risks. As with every network sector in the economy, it is possible for technology to fail us, but natural disasters and terrorism can also mean that part of the infrastructure is not available for a particular period of time. Such failures result in systemic risk if they happen at critical periods, such as at the end of the settlement day, during the day in the case of more protracted failures, or at times of great market uncertainty. In the case of a failure, settlement risk exposures can mount up and, within a day, can exceed the capital of each bank multiple times. In the case of a failure in

a RTGS, CCP or CSD, many banks will also face a system failure simultaneously. Moreover, an operational problem has the added complication of being unpredictable. This type of inherent infrastructure-related systemic risk originates from the inside and is therefore present on a permanent basis.

A second category of inherent infrastructure-related systemic risk is the risk of a bank failure. In this case, the settlement risk initially occurs in one bank because outgoing payments will no longer be made, but incoming payments will continue. The systemic risk can then manifest itself in the form of the feared domino effect: the initial problems lead to liquidity problems in other banks. Note that, in this case, the financial infrastructure does function correctly. This type of inherent infrastructure-related systemic risk originates from the outside and is therefore present if banks are at risk of getting into difficulties, particularly in the case of problems with a bank that is systemically important.[11]

This raises the question of what measures have been taken in the financial infrastructure to mitigate the inherent infrastructure-related systemic risk. International minimum standards have been drawn up for this purpose, which the central infrastructure, such as RTGS, CCP and CSD must meet. These standards are multidisciplinary in nature. They refer, among other things, to a sound legal basis, effective control of settlement, operational and financial risks, fair access criteria and good governance.[12] I will cover two examples here, one for each category of inherent infrastructure-related systemic risk referred to earlier.

An example of mitigation of inside originated systemic risk is the standard that a service disruption must be solved the same day; an accepted assumption is a maximum outage of two hours. There must be sufficient back-up so that if a data centre is affected by a disaster, the service can be resumed in another data centre that is not affected by the same disaster. The underlying principle is that the risk profiles of the two data centres must be sufficiently different so that one event cannot affect both centres. In practice, the target availability during normal opening hours is 99.5% or more.

[11] The term 'systemically important financial institution' was recently defined by the Financial Stability Board and adopted by the G20 in November 2010.

[12] These are referring to the Core Principles for Systemically Important Payment Systems of the Committee on Payments and Settlement Systems (CPSS) from 2001 and the Recommendations for Securities Settlement Systems and for Central Counterparties, respectively, of the joint working group of the CPSS-IOSCO (International Organization for Securities Commissions) from 2001 and 2004, respectively.

The second example, the control of outside originated systemic risk, is part of the standard for a sound legal basis in all of the jurisdictions in which the member banks of the settlement system are based. The principle is that the system must be final within the settlement day. This means that if a member bank fails, the payment instructions processed by the system can no longer be reversed. Such a provision therefore breaches the general provision of the Dutch Bankruptcy Act *(Faillissementswet)*, according to which, upon the failure of a business entity, all acts by that entity on that day are to be reversed to the position as at 12 midnight at the end of the preceding day. This provision is included in the European Settlement Finality Directive, thereby avoiding the need to have large numbers of settled transactions reversed, which would give rise to substantial uncertainty among all members of the system about the balances actually available to them at any time. Such final systems therefore provide for one-way traffic during the day: once transactions have been settled, they remain settled. This has the advantage for the creditor that the amount received in such a final system can be immediately available and reused.

Compliance with the standards referred to above is the responsibility of the governance authority of the financial infrastructure and is subject to oversight [3]. The overseers in the euro area are the national central banks and the ECB. There is also oversight of securities transactions by the securities regulators, which in the case of the Netherlands, are De Nederlandsche Bank and the Netherlands Authority for the Financial Markets. I will not be covering this regulatory task in further detail in my speech.[13] However, it should be noted that the total elimination of systemic risk is not possible because 100% security does not exist. Even if all of the measures have been taken, all standards have been complied with, and there are no further findings by the overseer, there is always a residual risk.

We will leave the thought experiment and turn our attention back to the financial infrastructure and all of the precautionary measures, and now examine the biggest test faced by the financial infrastructure in recent years: the period between September and October 2008. During these two months, the infrastructure-related systemic risk was higher than normal. This was very apparent from the risk of failure of large players in the financial markets, the higher numbers of transactions that had to be processed by the financial infrastructure, and the actual default of Lehman Brothers on 15 September 2008. Fortunately, the infrastructure proved able to deal effectively with this dangerous cocktail of events and emerged without sustaining major damage. There was, of course, a higher degree of alertness in the form of extra monitoring, and non-urgent modifications of the infrastructure's software and hardware was deferred for several months. Operational capacity

[13] The extent of compliance with the oversight standards for the infrastructure that is relevant to the Netherlands is available at www.dnb.nl/en/payments/oversight

proved to be sufficient to absorb peak values in transactions, and the financial buffers of central counterparties were high enough to absorb the collapse of Lehmans. During subsequent periods of market unrest, the financial infrastructure has also proved to be sufficiently robust. The impact of all of the failures of individual banks in recent years has been absorbed. Overall, the financial infrastructure has held up well, but it would be shortsighted to conclude from this that the financial infrastructure is totally crisis-resistant. It is, therefore, good to be able to report that the international oversight standards referred to are currently being revised by an international working party. It is important that certain aspects of the standards are tightened up.

Market-driven consolidation?

Above, we have considered the layout of the warehouse with a view to mitigating systemic risk. Although it is the primary focus for the risk standards that have to be met, it is not the whole story. After all, it could then be argued that the resilience of the financial infrastructure must always be increased, regardless of the costs. An alternative balancing perspective is needed, and this is the efficiency argument. Ultimately, the infrastructure must be used by banks, companies and consumers in a cost-effective way. There is also, therefore, an international standard that embraces this principle precisely. Given a certain robustness, the warehouse must be laid out as efficiently as possible, so that the utility function or basic service – the elimination of settlement risk – can be delivered to the rest of the economy at the lowest possible cost. This excludes the wide range of possible additional services that can be provided, in some cases bundled with the basic service, such as extending credit, invoicing or outsourcing the entire back office.

We have now arrived at the well-known phenomena in economics of the positive externality of a network and the economies of scale. I would like to illustrate this using the following puzzle:[14]

In a country far, far away lives King Greedy. He buys all sorts of things, mainly to make an impression on his subjects. His people are not allowed to buy the same item as the king within one month; it takes this long for the king to start to get tired of acquisition. His most recent purchases in random order are: fridge, camera, slippers, car, telephone and cactus. However, the king proclaimed that his subjects could purchase one of the items in the list immediately and what's more, he virtually demanded that they do so as soon as possible. Which item was it?

[14] Taken from puzzle no. 49 A Royal Show-off from *Professor Layton and Pandora's Box.*

The king knows only too well that a network with a size of $n = 1$ has no value: one telephone (this is the correct solution) in a kingdom is of no use. Positive externality arises by adding one new member to the payment system, which also makes the system more valuable for the existing members. The feature of the infrastructure is also that there are increasing returns from scale. The costs of the financial infrastructure are largely fixed costs, which means that marginal costs are relatively low. For this reason, the financial infrastructure is always said to be a volume game: the more transactions that pass through the same platform, the lower the costs per transaction. So, for the economy of the euro area as a whole, there are still substantial long-term efficiency gains to be made.

If the conditions for fair competition are met, it can be expected that in the long term, a single dominant infrastructure will be created. The one that is initially successful (for whatever reason) can reduce the costs through economies of scale and increase value by the network effect, thereby acquiring an ever larger market share. If we consider each country in the euro area individually, then the financial infrastructures for each basic function are often unique: one ACH, RTGS, CCP and CSD. In the Netherlands, the municipal giro services of Arnhem, Amsterdam, Bussum and Zaandam and the Rotterdam Stock Exchange were ultimately merged into larger entities in the last century. It therefore seems that, sooner or later – somewhat counter-intuitively – if there is sufficient competition between the markets, the end result for basic services in the new common market will often be a monopoly rather than full competition. Incidentally, experience shows that it is generally later rather than earlier. Such a monopoly does not need to be problematic, as long as it is contestable: new entrants must be able to enter the monopolist's market if they wish to and the margins on basic clearing and settlement services need to be modest. A very suitable business model would be one where the owners are users and which is geared toward cost recovery plus a small margin; the aim is not for Digiduck to become rich. Some argue that the euro area is too large for such a structure, but in the United States, the second floor of the dollar warehouse is heavily concentrated (see Figure 5).

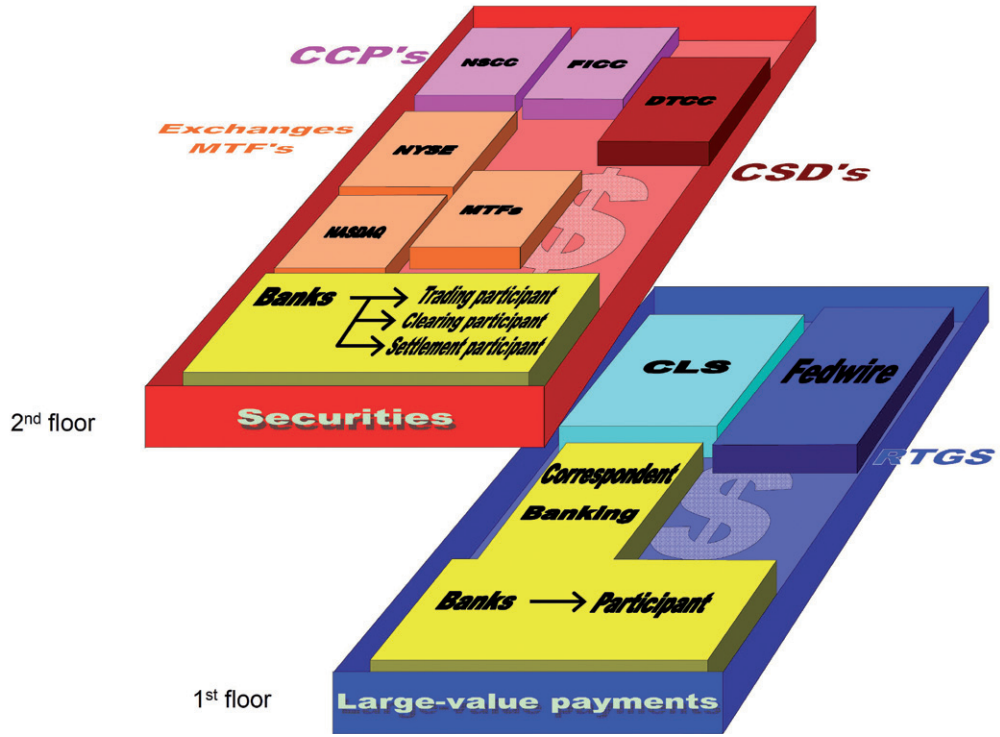

Figure 5 Securities in the United States (simplified diagram)

The conditions for such a market-driven consolidation have not yet been met, however, even though various initiatives have been started in recent years. In order to achieve a truly level playing field, at least three conditions need to be met.

1) A high degree of standardisation for the whole chain, so that the positive network externalities and economies of scale can actually be achieved. The importance of precise, open standards cannot be emphasised enough, and must not be a subject of competition. Legislation in relation to such basic products would need to take standards that are widely accepted in the market as a starting point and where they are missing legislation should prescribe the development of such standards.

2) The removal of cross-border legal barriers through the harmonisation of legislation at a national level and clear legislation at a European level. These barriers exist for the entire warehouse, but for the second floor, they have been known for the last decade as the Giovannini barriers, with examples being non-harmonised tax laws.

3) Vested interests must be broken up, because in the short term, there are always parties who benefit from the existing inefficiencies and then point to the high initial investment.

Incidentally, this does not mean that there should be no more competition in the entire warehouse in the long run. This might well need to be the case for additional services, such as in issuing and acquiring or custody services. I will not expand on this aspect here, because the more interesting question is how consolidation will take place. Assuming that consolidation will be market-driven, consolidation can be expected to take place through a combination of interoperability and mergers/acquisitions. Interoperability between two infrastructures means that a participant who is only a member of one infrastructure can still settle a transaction with a participant who is only a member of the other infrastructure.

The first example of consolidation by interoperability is that between central counterparties (CCPs) in Europe in relation to equity clearing. Although, from a risk perspective, the usual comments need to be made about the desirability of interoperability, I am only going to talk about the underlying reason here: five years ago, the European Commission and the securities industry agreed to introduce interoperable links. Two interoperable CCPs can each guarantee one of the two sides of a transaction via a link. As a result, counterparties only have to be a member of one interoperable CCP instead of a number of CCPs. In this way, they can save on membership costs and, overall, collateral costs as well. Given the competition between CCPs, it should come as no surprise that it is difficult to achieve interoperability. My expectation is that, at most, interoperability will be able to function as a catalyst to the consolidation of this category of CCPs on a temporary basis. It is more probable that consolidation will take place through mergers and acquisitions. In the somewhat longer term, interoperability between CCPs will disappear or become a marginal phenomenon.

A second example of consolidation is the Single Euro Payments Area (SEPA), which means I am fulfilling Digiduck's promise to return to the building alterations being carried out on the ground floor of the warehouse. SEPA is a large-scale restructuring of retail payments in the euro area, but also outside it, which is comparable to the launch of euro notes and coins. The fact is that the building alterations, which started several years ago, have become significantly delayed. To complete the building alterations, clearly defined standards need to be agreed for the whole chain, end-to-end. The existing standards for credit transfers and direct debits only apply to the interbank segment. Successful completion depends on the European regulations that are in the pipeline embracing these standards and prescribing that the bank-customer segment must also be standardised. In order to

be able to meet the third condition as well, a firm completion date needs to be set for the building alterations to ensure that they are finished. Another prerequisite for further consolidation is to make interoperability between all ACHs in Europe possible based upon a level playing field.

A third example is the building alterations on floor two, as promised, TARGET2-Securities and CCBM2. These projects were initiated by the Eurosystem. The aim is for TARGET2-Securities to take over DVP securities settlement from all CSDs in Europe that want it, thereby killing two birds with one stone. Because TARGET2-Securities is a single DVP platform, securities settlement is standardised and therefore a number of Giovannini barriers are removed, but interoperability between all CSDs is also achieved, as it were, automatically. This will then open the door to competition and consolidation of the settlement function of the CSDs in Europe with effect from 2014. Thereafter, we will be waiting for an initiative aimed at the further consolidation of the other functions of a CSD, such as the custody function. CCBM2 is the start of further harmonisation efforts to make the collateral process more efficient in the euro area.

These examples show that quite a lot of work is being done and, given the lead time of about five years for major infrastructure projects in the warehouse, the layout of the warehouse until 2015 is fairly clear. But, of course, you want to hear where it will all lead in the long term.

The ultimate warehouse

History teaches us that, when looking ahead into the distant future, it is wiser to predict that something is possible, rather than that something is impossible. You will therefore only hear from me what is possible in an ultimate warehouse, but without specifying a year. However, I will make a number of assumptions, as is normal practice in economics. I will assume that, in the distant future, there is still a form of money in the economy; for fans of the original Star Trek this is, incidentally, a bold assumption.[15] The currency of the euro area is still the euro and the euro area now includes more than 30 countries. And standards and European legislation in the field of infrastructure have been fully harmonised throughout the entire euro area. According to a descendant of Scrooge Digiduck, the position is as follows:

[15] In the original Star Trek series, it turned out there was no further role for money on earth. Money only appears in the Star Trek Encyclopaedia as an intergalactic medium of exchange.

1. **Full consolidation.** The temporary phase of interoperability between ACHs, CCPs and CSDs is far behind us, and the wave of consolidation through mergers and acquisitions has run its full course. As a result, substantial efficiency gains have been recorded at the level of the euro area and the costs per transaction are among the lowest in the world.

2. **One ACH and one CSD.** The ground floor has become very transparent: retail payments are cleared for the entire euro area in one ACH and are settled one floor higher in TARGET The Next Generation. There has also been substantial consolidation on the second floor, with the securities chain being structured by category of security and derivative. For equity and fixed income, there is a single integrated trading platform and warehouse; and there is one CSD called Securities The Next Generation.

3. **Settlement anywhere and at any time.** The financial infrastructure is available 24/7. The instruction for money settlement or securities settlement is generated by your mobile general purpose device, which you can use, for example, to project a holographic POS terminal. The mobile telephone is, after all, an old-fashioned way of making payment in 2015.

4. **T+3 settlement.** Transactions are recorded to the nearest nanosecond. Settlement at T+3 means three milliseconds later, instead of three days later. All payments and securities settlement are final within three milliseconds, and the assets can be reused immediately throughout the entire euro area. This has resulted in a major reduction in settlement risk exposures and, therefore, to infrastructure-related systemic risk.

5. **CCP for securities is redundant.** The central counterparty for securities (but not for derivatives) has become redundant, because no guarantee function is needed for settlement risk exposure that lasts a maximum of three milliseconds for end-to-end transactions. For derivative transactions on trading platforms and for OTC, there is a maximum of one CCP per asset class, as a result of which the settlement risk exposure is more concentrated, but substantially reduced by netting.

6. **End of the settlement day.** The term 'settlement day' is losing its meaning because there are no longer any technical or legal barriers to transfers in space or time. For this purpose, the 24/7 collateral pool was developed some time ago under the name CCBM The Next Generation. This also means the removal of the distinction between intraday and overnight credit. Interest will be calculated per second, and this ensures that consumers and businesses hold liquid assets on an interest-bearing basis and settle by automatic sweeps between the settlement account and the savings or custody account.

Conclusion

It is high time that we return to 2011 for three final comments.

First, in this inaugural address, I have argued for a holistic approach to the financial infrastructure, both in terms of the internal structure of the warehouse and geographically. I have deliberately taken the warehouse at the euro-area level as the starting point, since the Netherlands and every other individual European country is too small to compete on a global scale. It is important that infrastructure-related systemic risk continues to be properly controlled.

Second, I have said that I expect that consolidation will be market-driven, but for this to happen, it is vital that a genuinely level playing field is created. I have set out the conditions for this. Interoperability can play a useful role as a catalyst on a temporary basis, but ultimately mergers and acquisitions will be necessary for the permanent consolidation of the financial infrastructure in the euro area.

Third, I have outlined the ultimate warehouse. The intention behind this has been to show what could potentially become reality. The ultimate warehouse can serve as an alternative starting point for research and education. In the years to come, I will focus my research on issues such as the development of a functional model for the financial infrastructure as a whole, in accordance with the holistic approach outlined earlier. I recommend that this specialist field – because that's what financial infrastructure can be described as – be given its own Journal of Economic Literature code, since the current coding is too limited. Education begins, of course, with the function of money as a medium of exchange and, thereafter, hopefully the entire financial infrastructure will be presented to students on a systematic basis.

Acknowledgements

To close this speech, I would like to thank everyone who has contributed, either directly or indirectly, to my appointment as endowed professor of Financial Infrastructure and Systemic Risk. I would also like to name a number of them specifically.

I would like to thank the Executive Board of the University of Tilburg for appointing me and the members of the appointment advisory committee for their recommendation.

Professor Sylvester Eijffinger, ten years after your inaugural address at this university on competition between central banks, I am pleased to report that the price of banknotes has fallen after all. I look forward to working with you.

Professor Lex Hoogduin, in your inaugural address in Groningen that I attended, you created a special animal in the finance and banking industry, the *konifant*. It will be a challenge for me to research the financial infrastructure's *konifant*.

The members of the Governing Board of De Nederlandsche Bank, as sponsors of what is, at least in the Netherlands, the unique chair in Financial Infrastructure and Systemic Risk and, in particular, president Nout Wellink, who has fully supported the idea of the chair from the very beginning.

Professor Hennie Daniels, as your first PhD-student, I have had a tremendous time combining the fields of economics and artificial intelligence. An experience that is an excellent fit for financial infrastructure. I look forward to resuming our lunchtime walks through the De Warande park.

Henny van der Wielen, you managed to persuade me that working for the Cash and payment systems Division was certainly as interesting as working for the Economics and research Division of the Bank. I admit that you were right about this.

Coen Voormeulen, after your move to the payments side of the Bank, you asked me about my ambitions. Your immediate response to my reply was that you would like to see me in a gown. Duly noted.

Colleagues in the Cash and payment systems Division, I would like to thank you for our many discussions in recent years, from which I have learned a great deal about the financial infrastructure.

Dear Mum and dad, thank you for your support over many years; I am happy that you are here to see me fulfil my childhood dream.

My dear daughters, Caroline and Juliette, I would like to thank you for the binary version of Scrooge Digiduck and the King Greedy puzzle.

Dear Jacqueline, you are the one I can always rely on. It all began for us here in Tilburg, and I hope that it will continue for us for many more years yet.

I have said.

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Colophon

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